place of the various graptolitiferous deposits of Europe and America; and, basing his argument on his intimate knowledge of their included and peculiar forms, he endeavours to trace out the progress of the several genera and species, both in space and time. He infers that the evidences at his command show that the Skiddaw forms migrated southwards and westwards into Wales, Ireland, and America. Four species emigrated northwards into the Moffat area of the south of Scotland. This Moffat area became subsequently the birthplace of the genera *Retiolites*, *Cœnograptus*, *Rastrites*, and, most probably, *Pleurograptus* and *Monograptus*. It formed in its turn a grand centre of dispersion. To the south it furnished 55 per cent. of the later Coniston-Mudstone fauna. Its western emigrants, after peopling the Caradoc beds of the south of Ireland, crossed what is now the Atlantic, and reappeared in great force in the Utica Slates and Lorraine Shales at the summit of the Ordovician of New York and Canada. Easterly the course of the Moffat forms can be even more satisfactorily followed, their first resting-place being the Greywacke area of Saxony, whence they subsequently passed southwards into Barrande's Colonies and the band E*e* 1 of the Bohemian Basin.

[To be continued.]

XXIX.—*On the Occurrence of a small and new Phyllopod Crustacean, referable to the Genus* Leaia, *in the Lower Carboniferous Rocks of the Edinburgh Neighbourhood.* By R. Etheridge, Jun., F.G.S., of the British Museum.

The rapid increase in the number of invertebrate species lately discovered in the Calciferous Sandstone or Lower Carboniferous rocks of the south-east of Scotland, through the researches of the Geological Survey and of private collectors, has in a great measure tended to bridge over the gap which was formerly supposed to exist between the two important subdivisions of the Carboniferous system in Scotland—the Calciferous Sandstone series and the Carboniferous Limestone.

In continuing this subject* it is with much pleasure that I have to chronicle the discovery, by Mr. James Bennie, of a

* "On our Present Knowledge of the Invertebrate Fauna of the Lower Carboniferous, or Calciferous Sandstone Series, of the Edinburgh Neighbourhood, especially of that Division known as the Wardie Shales," Quart. Journ. Geol. Soc. 1878, xxxiv. p. 1.

small Phyllopod in the Wardie-Shale group of the rocks in question. It is either a new and peculiar form of the genus *Leaia*, or, as Prof. T. Rupert Jones was at first inclined to think, perhaps a species indicative of an undescribed genus.

The genus *Leaia* has not been previously unnoticed, however, in our Lower Carboniferous rocks. Many years ago the late Mr. J. W. Salter discovered a variety of the type species in the rocks of the Fifeshire coast, which was described by Prof. T. Rupert Jones as *L. Leidyi*, var. *Salteriana*.

A form of *Leaia* was found in an ironstone nodule from the Wardie Shales at Wardie, near Edinburgh, by Mr. C. W. Peach; and the discovery was noticed by Prof. Jones* and Mr. Peach†.

Leaia, notwithstanding its limited number of species, is now known to range from the uppermost part of the Old Red Sandstone (or lowest part of the Carboniferous ?) of Pennsylvania to the Coal-measures‡, although, so far as I am aware, it has not yet been met with in the Carboniferous Limestone.

The genus is described by Prof. Jones as possessing a markedly quadrate bivalved carapace, thin and horny, truncated and slightly curved behind, boldly rounded in front, and straight on the dorsal edge. The surface of the valves is concentrically ridged with lines of growth, and ornamented with a delicate reticulation in the intermediate furrows. Each valve is crossed by two conspicuous ridges: one of these passes directly across the valve from a slight anterior umbo to the antero-ventral angle; the other and longer forms a diagonal to the postero-ventral angle, thus dividing each valve into three unequal triangular areas. The concentric ridges (passing from one transverse ridge to the other) vary in their proximity one to another and in their relative strength of development. These are the characters derived from the type species and its varieties.

The form described by Meek and Worthen as *Leaia tricarinata*§ leads us a step further, and overrides the foregoing description as to one point. It corresponds in all essential particulars with the type species, but is said to possess a third carina or ridge, lying along the dorsal margin of each valve and enclosing what the authors term a "lanceolate corselet," or

* Geol. Mag. 1871, viii. p. 96.

† Brit. Assoc. Report for 1871, pt. 2, p. 109.

‡ Jones, Mon. Foss. *Estheriæ*, p. 117, &c.

§ Illinois Geol. Report, 1868. iii. p. 541; Jones, Geol. Mag. 1870, vii. p. 219.

"lanceolate false area." Meek and Worthen, however, admit that this peculiarity is not always to be seen, but only in those individuals which have not undergone pressure.

On this point Prof. Rupert Jones observes, "Messrs. Meek and Worthen have shown that in some species of *Leaia* there is evidently a third (dorsal) carina on each valve, bounding a dorsal depression (their 'lanceolate false area'), along the bottom of which is the hinge-line. In compressed specimens this is not distinguishable; and whether or no it is present in all they leave an open question"*. He adds, "As to outline and proportions, the many individuals on the shales found by Mr. W. Adams in South Wales comprise all the forms yet figured by Lea, Dawson, Meek and Worthen, and myself, and may be due to differences in age or sex, or conditions of preservation . . . . . It is, of course, probable that different 'species' did exist, and are represented amongst the different forms found in distant countries; but we still wait for further and decided evidences of specific characterization."

The sum of this evidence appears to be that, if further researches bear out the characters originally assigned to *Leaia*, as typified by *Cypricardia Leidyi*, Lea, and if the ridges have an important physiological meaning, then Meek and Worthen's species *L. tricarinata* should be considered generically distinct, provided the third carina on each valve, and the "lanceolate false area" enclosed thereby, are constant and well-defined characters, as, indeed, there does not appear any reason to doubt from the evidence of Meek and Worthen's figures B 2 and B 3.

On this point Prof. Jones has favoured me with the following remarks:—"It is possible, however, that if the two valves of *L. tricarinata* be opened out, in apposition, by their dorsal edges only, these particular *dorsal* carinæ may become obscured by pressure and imbedment; whereas if preserved in a good state with closed valves, and seen on the dorsal edge (as in Meek and Worthen's fig. B 3), the carapace then clearly shows the above-mentioned dorsal carinæ and the intervening elongate dorsal lunette. Certainly none of the published figures of open pairs of valves give any indication of the lanceolate corselet; and, unfortunately, *L. tricarinata* does not appear to have occurred in the opened-out position, so as to show its behaviour under pressure.

"One of the published species which is figured in the expanded condition of the valves is *Leaia Klieveriana*, Golden-

* Proc. Nat.-Hist. Soc. Cardiff, 1869, ii. p. 117: Geol. Mag. 1870, vii. p. 219.

berg*; and this shows no dorsal carina; but (if we interpret it aright) it has a peculiar short oblique ridge on each valve, intermediate to the vertical anterior and the longer oblique hinder ridge, starting with them from the umbo, but reaching across only about a third of the valve's width."

Let us now pass on to the fossil more recently discovered by Mr. Bennie, and compare it with *L. Leidyi* and *L. tricarinata*. The Granton species possesses to a great extent the quadrate form assumed by the others; but the angles and ventral edge are somewhat more rounded than in the type species and its variety *Williamsoniana*, and its angles are blunter than those of *L. tricarinata*. The surface is concentrically ridged, and the hinge-line straight, as in the others. The interesting feature, however, in connexion with this species, lies in the single ridge which crosses each valve in place of the two of *L. Leidyi*, the two and a half of *L. Klieveriana*, and the three of *L. tricarinata*. Instead of one from the umbo to the antero-ventral angle, and another forming a diagonal, as in the first—or a similar arrangement with the addition of a small, short, intermediate ridge, as in the second—or of a dorsal carina, as in the last,—the Granton specimens have only one cross ridge, that from the umbo to the antero-ventral angle, the diagonal and the dorsal ridges being, so far as we at present know, quite absent.

In the specimens before me this character is constant; and if, in the imperfect state of our knowledge of the species of this genus, the number of ridges on the carapace is to be taken as one of the chief points upon which to base separation, I think there can be no impropriety in assigning a special name to these individuals with a single ridge. Indeed Prof. Rupert Jones at first suggested to me the possibility of this being the type of a distinct "genus;" but he is now inclined to think that the cross ridges had better be regarded (provisionally at least) as specific characters, as we know nothing of the animal itself, and as there is but little in the shape of the valves that can be relied on as a constant character. Under these circumstances I shall content myself with describing the Granton specimens as *Leaia Jonesii*, as a slight recognition of the kindness and assistance I have always received at the hands of Prof. T. Rupert Jones, F.R.S. &c.

Leaia Jonesii, sp. nov. (Figs. 1, 2.)

Sp. char. Valves of the carapace oblong, very slightly and obliquely acuminate anteriorly, subtruncate and rounded

* Die fossilen Thiere aus der Steinkohlenformation von Saarbrücken, 1877, Heft 2, p. 46.

posteriorly; dorsal margin straight, ventral gradually rounded; convexity of valves unknown. Umbo inconspicuous in the crushed state. Surface ornamented with numerous (18–20) sharp concentric ridge-lines, and divided into two very unequal portions by a ridge proceeding vertically from the umbo to the antero-ventral curve, gradually losing its marked character as the umbo is receded from. The smaller of the two spaces is roundly triangular, and sometimes intruded on by an accidental fold due to pressure; the larger, comprising the greater part of each valve, is almost quadrate or oblong in form, allowing for the rounded infero-posterior margin.

Fig. 1. Fig. 2.

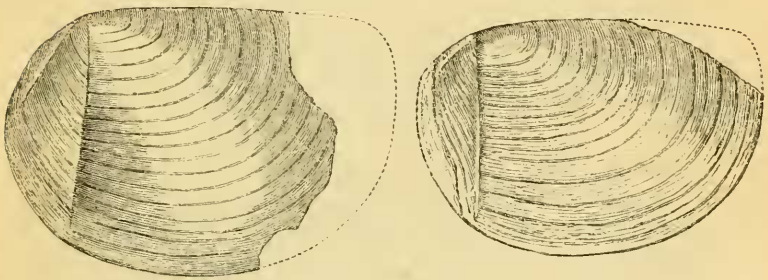

Fig. 1. A valve in which the posterior end has been destroyed; anterior to the ridge from the umbo is a furrow caused by pressure. It is quite distinct from the ridge.

Fig. 2. Another valve, with the rounded posterior end somewhat deficient; the same fold occurs here.

The figures are magnified to about eight times the natural size. The specimens are contained in the Geological-Survey-of-Scotland collection.

Obs. Exclusive of the single ridge existing in the present species, it has much less angularity of outline than *L. Leidyi*, Lea, and somewhat less than *L. tricarinata*, M. & W., and in this respect corresponds more closely with *L. wettinensis*. It is longer than *L. Bæntschiana*.

Form. and Loc. Shore of the Firth of Forth at Granton Quarry, near Edinburgh, in a fine-grained shale of the Wardie-Shale group, Lower Carboniferous or Calciferous-Sandstone series. Collection of the Geological Survey of Scotland.

Collector. Mr. James Bennie.

I have to express my thanks to Prof. A. Geikie, F.R.S., for permission to make use of the specimens, and to Prof. T. Rupert Jones, F.R.S., for material assistance in working out the form here described.

The following synopsis of the species of *Leaia* known to me may be found useful:—

Genus Leaia, Jones, 1862.

Leaia Leidyi, Lea (1856).

Cypricardia Leidyi, Lea, Proc. Acad. Nat. Sci. Philad. 1856, vii. p. 341, t. 4.

Leaia Leidyi, Jones, Mon. Foss. Estheriæ, 1862, p. 116, t. 5. f. 11, 12; Dawson, Acadian Geol. 1868, p. 256, f. 78 *e*; Jones, Proc. Nat. Hist. Soc. Cardiff, 1869, ii. p. 117, t. 3. f. 11–14; Jones, Geol. Mag. 1870, vii. p. 219, t. 9. f. 11–14; Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 740, t. 16. f. 3; Miller, Cat. American Pal. Foss. 1877, p. 219; Woodward, Cat. Brit. Foss. Crustacea, 1877, p. 76; Goldenberg, Fauna Saræpontana Foss. Heft 2, 1877, p. 45, t. 2. f. 22; Bigsby, Thes. Dev.-Carbonif. 1878, pp. 250, 251.

Loc. and Horizon. Tumbling-Run dam, near Potsville (Penn.), in the uppermost portion of the Old Red Sandstone (? or base of the L. Carboniferous); Coal Measures of South Wales.

Leaia Leidyi, var. *Williamsoniana*, Jones (1862).

Bivalvular shell, Williamson, Phil. Mag. 1836, n. s. ix. p. 351.

Aptychus?, Phillips, Murchison's Sil. Syst. 1839, p. 89.

Leaia Leidyi, var. *Williamsoniana*, Jones, Mon. Foss. Estheriæ, 1862, p. 117, t. 1. f. 19–29; Woodward, Cat. Foss. Crustacea, 1877, p. 76; Goldenberg, Fauna Saræpontana Foss. Heft 2, 1877, p. 45, t. 2. f. 23; Bigsby, Thes. Devon.-Carbonif. 1878, p. 251.

L. Williamsoniana, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 743, t. 16. f. 4.

Loc. and Horizon. Ardwick, near Manchester, in uppermost portion of Coal-measures.

Leaia Leidyi, var. *Salteriana*, Jones (1862).

L. Leidyi, var. *Salteriana*, Jones, Mon. Foss. Estheriæ, 1862, p. 119, t. 1. f. 1; Woodward, Cat. Foss. Crustacea, 1877, p. 76; Goldenberg, Fauna Saræpontana Fossilis, Heft 2, 1877, p. 45; Bigsby, Thes. Dev.-Carbonif. 1878, p. 251.

L. Salteriana, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 744, t. 16. f. 5.

Loc. and Horizon. Cottage Row, Crail, Fife, in rocks of the Lower Carboniferous or Calciferous Sandstone series.

Leaia Bœntschiana, Geinitz (1864).

L. Bäntschiana, Geinitz, N. Jahrbuch, 1864, p. 657; id. ibid. 1865, p. 389, t. 1. f. 2, 3.

L. Leidyi, var. *Bäntschiana*, Beyrich, Zeitschr. deutsch. geol. Gesellsch. 1864, xvi. p. 364.

L. Bœntschiana, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 744, t. 16. f. 2.

L. Leidyi, var. *Bœnschiana*, Goldenberg, Fauna Saræpontana Fossilis, Heft 1, 1873, p. 24.
L. Leidyi, var. *Bœntschiana*, Goldenberg, *op. cit.* Heft 2, 1877, p. 46, t. 2. f. 24.

Loc. and Horizon. Near Neun Kirchen, in rocks of Lower Permian age.

Leaia tricarinata, Meek and Worthen (1868).

L. tricarinata, M. & W. Illinois Geol. Report, 1868, iii. pp. 540, 541, f. B. 1–3, and ? C; Miller, Cat. American Pal. Foss. 1877, p. 219; Bigsby, Thes. Dev.-Carbonif. 1878, p. 250.

Loc. and Horizon. La Salle County, in lower portion of true Coal-measures; ? St. Clair County, in Upper Coal-measures; Vermillion County, Illinois, in the Lower true Coal-measures.

Leaia wettinensis, Laspeyres (1870).

L. Wettinensis, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. pp. 733–745, t. 16. f. 1; Bigsby, Thes. Dev.-Carbonif. 1878, p. 251.

Loc and Horizon. Wettin, Coal-measures.

Leaia Klieveriana, Goldenberg (1873).

L. Leidyi, var. *Klieveri*, Goldenberg, Fauna Saræpontana Foss. Heft 1, 1873, p. 24, t. 1. f. 22.
L. Leidyi, var. *Klieveriana*, Goldenberg, *op. cit.* Heft 2, 1877, p. 46, t. 2. f. 20, 21.

Loc. and Horizon. Saarbrück, Coal-measures.

Leaia, sp. ind.

Leaia, sp., Jones, Geol. Mag. 1871, vii. p. 96; C. W. Peach, Brit. Assoc. Report for 1871, pt. 2, p. 109; Etheridge, Jun., Quart. Journ. Geol. Soc. 1878, xxxiv. pp. 5, 23.

Loc. and Horizon. Ironstone nodule in Wardie Shales, at Wardie, near Edinburgh, Lower Carboniferous series.

XXX.—*Notes on the Species of* Peripatus, *and especially on those of Cayenne and the West Indies.* By H. N. Moseley, F.R.S., Fellow of Exeter College, Oxford.

About two years ago Dr. Günther kindly sent to me for examination a specimen of *Peripatus* received by him from the Amazons; and I also received about the same time a further specimen from the late Mr. Thomas Belt. In attempting to determine the species of these specimens I found many difficulties in the way; and I therefore examined the series of